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The event plane calibration in the MBD in the 2023 commissioning data

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Abstract

This is a short approval note in support of the event plane calibration process of the MBD event plane during Run 2023.

Introduction

The event plane is used in many physics analyses of interest to the collaboration. We refer the reader to our previous note linked [here], which describes the event plane determination and first order correction by recentering the flow vectors. In the previous note, the event plane shifting procedure is implemented for the plots shown in the result section. In this note, we explicitly describe the event plane shifting procedure and extract the Ψ_n distributions employing calibration steps described in the previous and current note. The event-by-event shifting of the planes requires that one fits the non-flat distribution of the event planes summed over all events to a Fourier expansion and devise the shift necessary to force a flat distribution.

The equation for the shift is [1]:

$$n\Delta\Psi_n = \sum_{i}^{i_{max}} = \frac{2}{i}(-\langle sin(in\Psi_n)\rangle cos(in\Psi_n) + \langle cos(in\Psi_n)\rangle sin(in\Psi_n)) \quad (1)$$

The value of i_{max} used in this analysis is 6.

Run selection and code

The code used for this analysis is linked [here]. The plots in this note use run 21813 and production build DST_ana395_2023p007.

Results

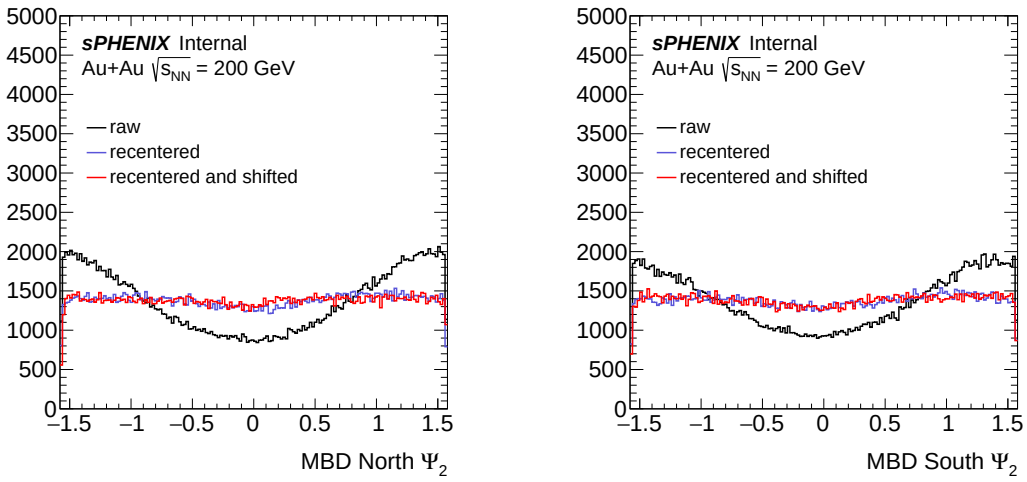

Figure 1: Event plane calibration steps of the second order event plane angle using the MBD north arm (left); showing the raw, recentered, and the recentered and shifted distributions in black, blue, and red respectively. The right figure shows the corresponding distributions using the MBD south arm.

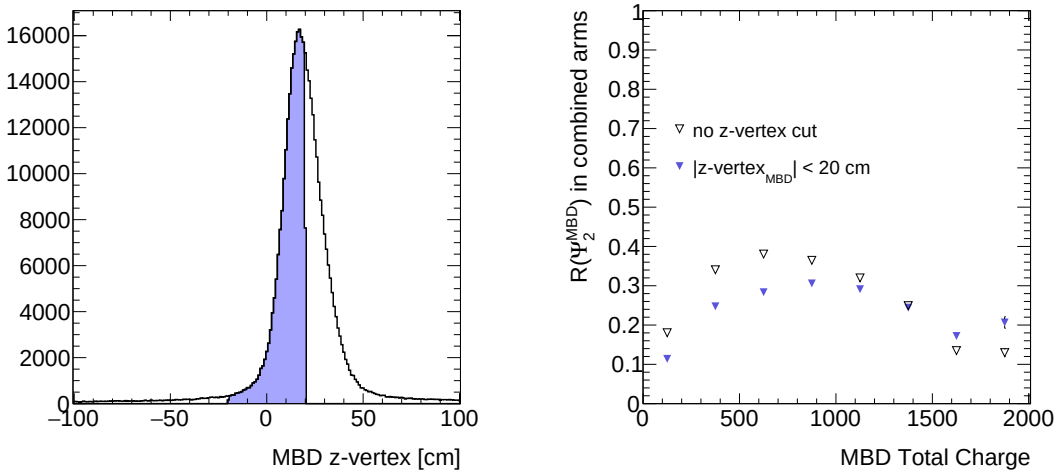

Figure 2: Left figure shows the MBD z-vertex distribution in black, and a $|z - vertex_{MBD}| < 20$ cm region in blue of selected events used in this analysis. The right figure shows the event plane resolution with and without the imposed z-vertex cut.

The one dimensional second order event plane distributions shown in this section are within $|z - vertex_{MBD}| < 20$ cm. The event plane is calibrated in bins of MBD total charge with a width of 5. The maximum order of 6 used in the angle shift in this note is the same as in the previous note. Figure 2 show the vertex distribution in run 21813 and the calculated event plane resolution.

References

1. Arthur M. Poskanzer and S. A. Voloshin. Methods for analyzing anisotropic flow in relativistic nuclear collisions. *Z. Phys. Rev. C*, 58:1671–1678,1998. doi:10.1103/PhysRevC.58.1671.